Center Innovation Fund: MSFC CIF

Utilizing Bosch Generated Carbon for Additive Manufacturing

Completed Technology Project (2017 - 2018)

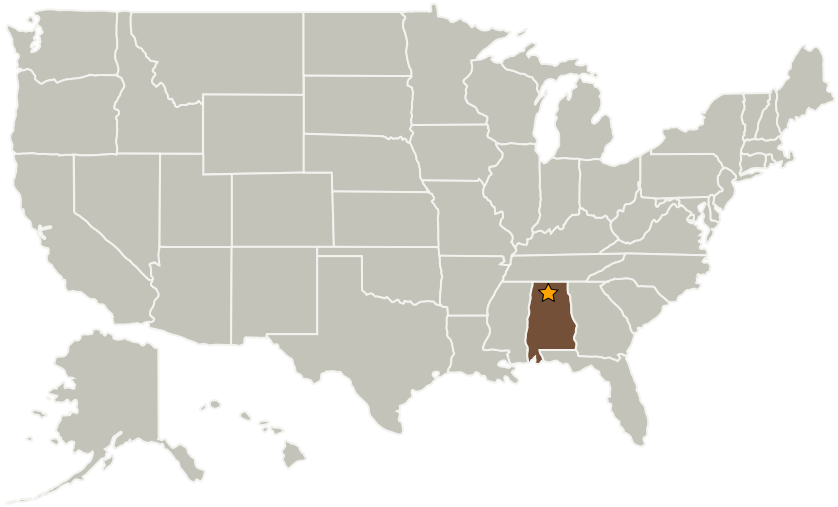
Project Introduction

Additive manufacturing onboard ISS provides the ability to manufacture parts on demand allowing for critical replacement parts and tools to be manufactured without the need to wait for them to arrive. ABS filament is used on ISS for additive manufacturing, and although ABS is a relatively strong plastic, when ABS manufactured parts are used as tools there is a great chance of the manufactured parts to fracture. The addition of carbon to the ABS filament is likely to solve this issue and the issue of Bosch waste carbon utilization.

Anticipated Benefits

ABS materials physical, electrical, and optical characteristics can be improved by the addition of carbon. Carbon has long been used in industry as a reinforcement providing structural strength to materials. The addition of Bosch carbon to ABS filament could greatly increase the structural strength of manufactured parts allowing for more durable and reliable parts to be printed, as well as utilizing a waste product of the Bosch reaction.

Primary U.S. Work Locations and Key Partners



Carbon-coated Iron wool catalyst generated from the Bosch process from previous Bosch catalyst development testing.

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Organizations Performing Work	Role	Type	Location
★Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
The University of Alabama	Supporting Organization	Academia	Tuscaloosa, Alabama

Primary U.S. Work Locations
Alabama

Project Transitions

October 2017: Project Start

September 2018: Closed out

Closeout Summary: For long duration life support missions, oxygen recovery f rom metabolic CO2 is essential. Currently, the ISS oxygen recovery system is ca pable of recovering approximately 50% of the oxygen from metabolic carbon dio xide. However, for long duration manned missions, a minimum of 75% with a ta rget of 90% of oxygen recovery is required. Theoretically, the Bosch process can recover 100% of oxygen from metabolic CO2, making it a desirable technology f or oxygen recovery for long duration missions. The Bosch process reacts carbon dioxide (CO2) with hydrogen (H2) to produce water (H2O) and elemental carbon (C) in the presence of a catalyst. The water that is produced in the Bosch proces s is fed to the Oxygen Generation Assembly (OGA) where it is then electrolyzed to form gaseous H2 and O2. H2 is recycled back to the Bosch process and O2 is returned to the atmosphere. Carbon builds up and fouls the catalyst at a rate of 1 kg per day. Finding useful ways to utilize the carbon produced in the Bosch pr ocess would be very beneficial. One area of particular interest is additive manuf acturing. Additive manufacturing onboard ISS provides the ability to manufactur e parts on demand allowing for critical replacement parts and tools to be manuf actured without the need to wait for them to arrive. ABS filament is used on ISS for additive manufacturing, and although ABS is a relatively strong plastic, when ABS manufactured parts are used as tools there is a great chance of the manufa ctured parts to fracture. The addition of carbon to the ABS filament is likely to s olve this issue.

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Center Innovation Fund: MSFC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

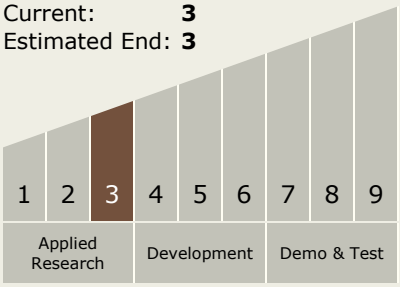
John W Dankanich

Principal Investigator:

Brittany J Brown

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **3**



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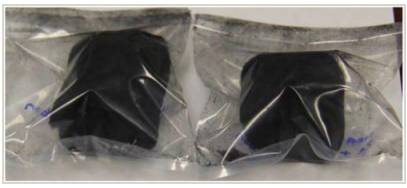
Images



Project Image
Carbon-coated Iron wool catalyst generated from the Bosch process from previous Bosch catalyst development testing.
(https://techport.nasa.gov/image/35811)

Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VC

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.2 Mission Infrastructure, Sustainability, and Supportability
    - TX07.2.2 In-Situ Manufacturing, Maintenance, and Repair

Target Destinations

Earth, The Moon, Mars